

WHAT IS CLAIMED IS:

1. A cooling apparatus for use with an optical element having a concave part, said cooling apparatus
5 comprising a cooling mechanism, located in the concave part of the optical element, for cooling the optical element through radiation in a non-contact manner.

2. An optical element comprising:
10 a base having a surface to be illuminated by light, and a first concave part; and
a cooling mechanism, located in the first concave part, for cooling said base through radiation in a non-contact manner.

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3. An optical element according to claim 2, wherein the surface has an area to be illuminated, and the first concave part is located opposite to the area on the surface.

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4. An optical element according to claim 2, wherein said cooling mechanism includes:
a radiation plate provided opposite to the base; and
25 a Peltier element that cools the radiation plate.

5. An optical element according to claim 4,
wherein said cooling mechanism has a channel for
coolant to flow, and further includes a cooling jacket
for recovering heat from the Peltier element.

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6. An optical element according to claim 2,
wherein said cooling mechanism further includes a heat
insulator for preventing the base from absorbing heat
obtained by the first concave part.

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7. An optical element according to claim 2,
wherein the base has a second concave part provided at
a position different from that of the first concave
part in a non-illuminated area.

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8. An optical element according to claim 7,
wherein the second concave part is opposite to the non-
illuminated area on the surface to be illuminated.

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9. An optical element according to claim 3,
wherein an interval between the area to be illuminated
and the first concave part is made almost constant.

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10. An optical element according to claim 3,
wherein the first concave part has a shape that changes
according to temperature distributions on the surface
to be illuminated.

11. An optical element according to claim 3,
wherein the cooling mechanism changes cooling power
based on a position according to temperature
distributions on the surface to be illuminated.

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12. An optical element according to claim 2,
further comprising a mirror.

13. An optical element according to claim 2,
10 further comprising:
a detector for detecting a temperature of
said base; and
a controller for controlling said cooling
mechanism so that the temperature of said base detected
15 by said detector becomes a predetermined value.

14. An optical element comprising a surface to be
illuminated by light, said optical element having a
concave part opposite to the surface.

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15. An exposure apparatus comprising an optical
system for exposing a pattern formed on a mask or a
reticle onto an object, wherein said optical system
includes an optical element, and the optical element
25 includes a base having a surface to be illuminated by
light, and a first concave part, and a cooling
mechanism, located in the first concave part, for

cooling said base through radiation in a non-contact manner.

16. An exposure apparatus comprising an optical
5 system for exposing a pattern formed on a mask or a reticle onto an object, wherein said optical system includes an optical element, and the optical element has a surface to be illuminated by light, and a concave part opposite to the surface.

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17. A device fabricating method comprising the steps of:

exposing a pattern on a mask or a reticle
onto an object using an exposure apparatus that

15 includes an optical system, wherein said optical system includes an optical element, and the optical element includes a base having a surface to be illuminated by light, and a first concave part, and a cooling mechanism, located in the first concave part, for
20 cooling said base through radiation in a non-contact manner; and

developing the exposed object.

18. A device fabricating method comprising the
25 steps of:

exposing a pattern on a mask or a reticle
onto an object using an exposure apparatus that

includes an optical system, wherein said optical system includes an optical element, and the optical element has a surface to be illuminated by light, and a concave part opposite to the surface; and

5 developing the exposed object.